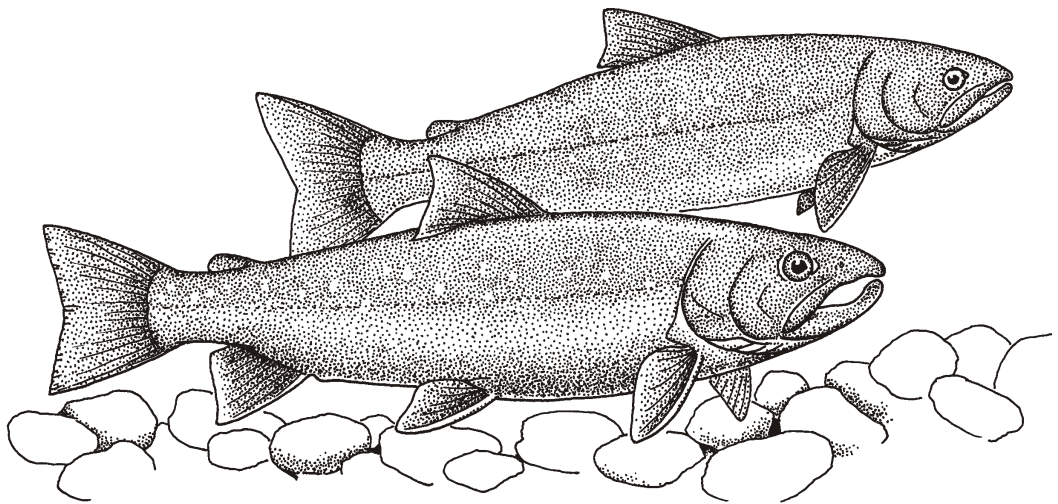


Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout (*Salvelinus confluentus*)

Volume II (of II)
Olympic Peninsula Management Unit



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Draft Recovery Plan
for the
Coastal-Puget Sound Distinct
Population Segment
of
Bull Trout (*Salvelinus confluentus*)

Volume II (of II)

Olympic Peninsula Management Unit

(May 2004)

Region 1
U.S. Fish and Wildlife Service
Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
Regional Director, U.S. Fish and Wildlife Service

Date: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect the species. Recovery plans are prepared by the U.S. Fish and Wildlife Service and, in this case, with the assistance of recovery teams, State, Federal, and Tribal agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views or the official positions or indicate the approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service *only* after they have been signed by the Director or Regional Director as *approved*. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

Literature citation of this document should read as follows:

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Electronic copies of this recovery plan are available at:

<<http://pacific.fws.gov/ecoservices/endangered/recovery/default.htm>> and also at <<http://endangered.fws.gov/recovery/index.html>>.

Note to readers: A glossary of technical terms is provided in Appendix 6 of this plan. Terms provided in the glossary are denoted with a superscript symbol (†) the first time they appear in the plan.

ACKNOWLEDGMENTS

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EXECUTIVE SUMMARY

The Olympic Peninsula Management Unit is one of two management units[†] comprising the Coastal-Puget Sound Distinct Population Segment[†] of bull trout (*Salvelinus confluentus*). The overall recovery implementation strategy for the Coastal-Puget Sound Distinct Population Segment is to integrate with ongoing Tribal, State, local, and Federal management and partnership efforts at the watershed[†] or regional scales. This coordination will maximize the opportunity for complementary actions, eliminate redundancy, and make the best use of available resources for bull trout and salmon recovery.

Current Species Status

We, the U.S. Fish and Wildlife Service, issued a final rule listing the Coastal-Puget Sound and St. Mary-Belly River Distinct Population Segments as threatened on November 1, 1999 (64 FR 58910). This final rule resulted in all bull trout within the coterminous United States being listed as threatened, as three additional distinct population segments had earlier been listed separately (the Klamath River, Columbia River, and Jarbidge River Distinct Population Segments; 63 FR 31647, 64 FR 17110). As provided in the final listing rule, however, we are continuing to refer to the original distinct population segments for the purposes of recovery planning and consultation (64 FR 58910). The Coastal-Puget Sound Distinct Population Segment is significant to the species as a whole because it contains the only anadromous[†] forms of bull trout in the coterminous United States, thus, occurring in a unique ecological setting. Also unique to this population segment is the overlap in distribution with Dolly Varden, another native char[†] species extremely similar in appearance to bull trout, but distinct genetically.

The Olympic Peninsula Management Unit includes all watersheds within the Olympic Peninsula and the nearshore marine waters of the Pacific Ocean, Strait of Juan de Fuca, and Hood Canal. Bull trout, which are distributed throughout most of the major watersheds and associated tributary systems within this management unit, exhibit anadromous, adfluvial[†], fluvial[†], and possibly resident[†] life history patterns. The Olympic Peninsula Management Unit consists of 6 core areas[†] (a core area consists of one or more local populations[†] of bull

trout and their habitat), with a total of 10 local populations and 2 potential local populations[†] distributed among the core areas.

Recovery Priority

The recovery priority number for bull trout in the coterminous United States is 9C, on a scale of 1C (highest) to 18 (lowest), indicating: 1) taxonomically, we are treating these populations as distinct population segments of the species; 2) the bull trout is subject to a moderate degree of threat; and 3) the potential for recovery is considered high. The “C” indicates the potential for conflict with human activities during recovery (USFWS 1983a,b).

Habitat Requirements and Limiting Factors

Bull trout have more specific habitat requirements than most other salmonids. Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors[†]. Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found in colder streams (below 15 degrees Celsius; 59 degrees Fahrenheit), and spawning habitats are generally characterized by temperatures that drop below 9 degrees Celsius (48 degrees Fahrenheit) in the fall. All life history stages of bull trout are associated with complex forms of cover, including large woody debris[†], undercut banks, boulders, and pools. Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns. Additionally, since bull trout are iteroparous (they survive to spawn year after year) and many populations are migratory, these fish therefore require two-way passage up and downstream, not only for repeat spawning but also for foraging. Therefore even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide adequate two-way passage for subadults and adults.

Within the Olympic Peninsula Management Unit, historical and current land use activities and fisheries management have impacted bull trout. Some of the historical activities, especially water diversions, hydropower development, forestry, agriculture, fisheries management, and residential and urban

development within the core areas, may have significantly reduced important migratory populations. Lasting effects from some, but not all, of these early land and water developments still act to limit bull trout production in core areas. Threats from current activities are also present in all core areas of the Olympic Peninsula Management Unit. Land and water management activities that depress bull trout populations and degrade habitat in this management unit include some aspects of operation and maintenance of dams and other diversion structures, forest management practices, agriculture practices, road construction and maintenance, and residential development and urbanization. Dams and diversion structures impede or limit migration, entrain[†] individuals, and impair downstream habitat. Forestry activities impact bull trout through decreased recruitable large woody debris[†], increased water temperatures from reduced shading, lack of pools and habitat complexity, and increased sedimentation from timber harvesting on unstable slopes and road construction. Agriculture practices impact bull trout through added inputs of nutrients, pesticides, herbicides, sediment, reduced riparian[†] vegetation, decreased recruitable large woody debris, and reduced habitat complexity by diking, stream channelization[†], and bank hardening. Road construction and maintenance impact bull trout through added channel constrictions, impassible culverts, bank hardening, sedimentation, reduction in riparian shading, contaminant inputs, and impervious surfaces. Development and urbanization impact bull trout through reduced water quality, changed hydrology, reduced riparian shading, sedimentation, and reduced channel complexity from increased bank hardening and channel constrictions. Historical and current incidental mortality to bull trout from Tribal and recreational fisheries are considered a significant threat to populations on the Olympic Peninsula. The presence of nonnative species[†] such as brook trout continue to pose a threat through competition, hybridization[†], and potential predation in some core areas.

Recovery Strategy

Presently bull trout are listed as threatened across their range within the lower 48 states (64 FR 58910). Prior to the coterminous listing, five distinct population segments of bull trout were identified. Although these bull trout population segments are disjunct and geographically isolated from one another, they include the entire distribution of bull trout within the United States, therefore a coterminous listing was found to be appropriate in accordance with our policy

on the designation of distinct population segments (61 FR 4722). As provided in the final listing rule, we are continuing to use the term “distinct population segments” for the purposes of recovery planning and consultation (64 FR 58910).

A delisting determination can only be made on a “listable entity” under the Endangered Species Act (Act). Listable entities include species, subspecies, or distinct population segments of vertebrate animals, as defined by the Act and U.S. Fish and Wildlife Service Policy (61 FR 4722). Because bull trout were listed at the coterminous level in 1999, currently delisting can only occur at the coterminous level (64 FR 58910). In the future, if warranted by additional information, and if the Coastal-Puget Sound population is reconfirmed as meeting the definition of a distinct population segment under a regulatory rulemaking, delisting may be considered separately for the Coastal-Puget Sound Distinct Population Segment of bull trout once it has achieved a recovered state (61 FR 4722).

The recovery of the Coastal-Puget Sound Distinct Population Segment of bull trout will depend upon the achievement of recovery goals and criteria for the entire distinct population segment. Maintenance of fully functioning core areas across the range of bull trout within the population segment will require that each of the two management units that comprise this distinct population segment contribute to the success of this effort. In keeping with the goal of fostering effective management and recovery of bull trout at the local level, we have developed separate recovery plans for each of these management units, and established specific “recovery targets” for each management unit that will be used to guide bull trout recovery within the distinct population segment as a whole.

Here we define the recovery criteria for the delisting of the Coastal-Puget Sound Distinct Population Segment of bull trout as currently delineated. The site-specific strategies, recovery actions, and recovery targets for the Olympic Peninsula Management Unit are presented in Part II of this plan. The Puget Sound Management Unit is addressed in Volume I of the Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout.

Recovery Goal for the Coastal-Puget Sound Distinct Population Segment

The goal of this recovery plan is to **ensure the long-term persistence of self-sustaining, complex interacting groups[†] of bull trout distributed across the Coastal-Puget Sound Distinct Population Segment, so that the species can be delisted.**

Recovery Criteria for the Coastal-Puget Sound Distinct Population Segment

The Coastal-Puget Sound Distinct Population Segment will be considered recovered when all core areas are fully functional, as measured by parameters addressing the distribution, abundance, productivity (stable or increasing adult population trend), and connectivity (including the potential for expression of all life history traits) of bull trout. The recovery actions identified in this plan are designed to sufficiently control or eliminate the threats to bull trout such that the recovery criteria may be attained for the Coastal-Puget Sound Distinct Population Segment. The conditions for recovery are identified in the following criteria:

1. The biological and ecological function of the 14 identified core areas (6 in the Olympic Peninsula Management Unit and 8 in the Puget Sound Management Unit) for bull trout within the distinct population segment has been restored. The components of fully functioning core areas include:

- a) Habitat sufficiently maintained or restored to provide for the persistence of broadly distributed local populations supporting the migratory life form within each core area.** The term “broadly distributed” implies that local populations are able to access and are actively using habitat that fully provides for spawning, rearing, foraging, migrating, and overwintering needs at recovered abundance levels. An actual quantitative estimate of the amount of habitat that will be required to meet this criterion is unknown at this time; the adequacy of habitat restoration and management efforts must be measured indirectly by criteria 1b through 1d. The currently identified local populations that will be used as a measure of broad distribution across the distinct population segment are detailed in the recovery targets set for each of the two management units.

- b) Adult bull trout are sufficiently abundant to provide for the persistence and viability of core areas; this level of abundance is estimated to be 16,500 adult bull trout across all core areas.**

Resident life history forms are not included in this estimate, but are considered a research need. As more data is collected, recovered population estimates will be revised to more accurately reflect both the migratory and resident life history components. The recovery team[†] has initially set abundance targets conservatively if there was limited available information for constituent core areas; these will likely be revised as new information becomes available. The recovered abundance levels for the currently identified core areas in the distinct population segment are detailed in the recovery targets set for each of the two management units.

- c) Measures of bull trout abundance within all core areas show stable or increasing trends based on 10 to 15 years (representing at least 2 bull trout generations) of monitoring data.** Details are provided in the recovery targets for each of the two management units.

- d) Habitat within, and where appropriate, between core areas, is connected so as to provide for the potential of the full expression of migratory behavior (particularly anadromy), allow for the refounding[†] of extirpated populations, and provide for the potential of genetic exchange between populations.** Meeting this criterion requires that passage has been restored or improved, and in some cases further evaluated, at specific barriers identified as inhibiting recovery (including barriers due to physical obstructions, unsuitable habitat, and poor water quality). Known barriers to passage within the Olympic Peninsula Management Unit include Cushman Dams 1 and 2, Elwha Dam and Glines Canyon Dam, the Washington Department of Fish and Wildlife Dungeness Fish Hatchery, and U.S. Fish and Wildlife Service Quinalt National Fish Hatchery. Known barriers to passage within the Puget Sound Management Unit include the Bellingham Diversion, Gorge Dam, Ross Dam, Tacoma Headworks diversion dam, and Howard Hansen Dam; the Baker River Dams and Electron and Buckley diversions are also in need of passage

improvement. Details regarding these specific barriers are provided in the recovery targets set for each of the two management units.

Meeting this criterion also requires that conditions in both freshwater and nearshore marine foraging, migration, and overwintering habitats[†] are maintained and/or restored to the level that fully support an adequate prey base, especially for the anadromous forms, as well as the other identified components (distribution, abundance, and trend) for fully functional core areas within the Coastal-Puget Sound population segment.

2. A monitoring plan has been developed and is ready for implementation, to cover a minimum of 5 years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

Recovery targets for the Olympic Peninsula Management Unit:

- 1. Maintain or expand the current distribution of bull trout in the six identified core areas.** The 10 currently identified local populations (Skokomish (2), Dungeness (2), Elwha (1), Hoh (2), Quinault (2), Queets (1)) will be used as a measure of broadly distributed spawning and rearing habitat within these core areas. In addition, spawning distribution in the two potential local populations that are essential to recovery (one in the Skokomish core area, one in the Elwha) should be restored or confirmed.
- 2. Achieve minimum estimated abundance of at least 5,700 adult bull trout spawners in the Olympic Peninsula Management Unit, including at least 1,000 spawning adults in each of the Dungeness, Elwha, Hoh, Queets, and Quinault core areas and at least 700 spawning adults in the Skokomish core area.** Estimates of the recovered abundance for bull trout in this management unit are based on a recommended minimum abundance of 1,000 adult spawners to reduce the likelihood of genetic drift and the professional judgement of the recovery team. Estimates also included consideration of surveyed fish densities, habitats, and potential fish production after threats have been addressed. The recovered abundance level in the Skokomish core area will be limited by available

habitat and is estimated to be 700 adult spawners when the core area reaches its recovered potential.

3. **Restore adult bull trout to exhibit stable or increasing trends in abundance at or above the recovered abundance level within the core areas in the Olympic Peninsula Management Unit based on 10 to 15 years (representing at least 2 bull trout generations) of monitoring data. (Note: generation time varies with demographic variables such as age at maturity, fecundity, frequency of spawning, and longevity, but typically falls in the range of 5 to 8 years for a single bull trout generation).**
4. **Restore connectivity by identifying and addressing specific existing and potential barriers to bull trout movement in the Olympic Peninsula Management Unit.** Connectivity criteria will be met when intact migratory corridors are present among all local populations within each core area, thus providing opportunity for genetic exchange and life history diversity. Several man-made barriers to bull trout migration exist within the management unit, and this recovery plan recommends actions to identify, assess, and reduce barriers to bull trout passage. Although achieving criteria 1 through 3 is expected to depend on providing passage at barriers (including barriers due to physical obstructions, unsuitable habitat, and water quality) throughout all core areas in the management unit, the intent of this criterion is to note specific barriers to address, or actions that must be performed to achieve recovery.

Recovery Actions

Recovery for bull trout will entail reducing threats to the long-term persistence of populations and their habitats, ensuring the security of multiple interacting groups of bull trout, and providing habitat and access to conditions that allow for the expression of various life history forms. Detailed actions specific to this management unit are provided in this plan; in broad terms, these actions include:

1. Protect, restore, and maintain suitable habitat conditions for bull trout.

2. Prevent and reduce negative effects of nonnative fishes and other nonnative taxa on bull trout.
3. Establish fisheries management goals and objectives for compatibility with bull trout recovery, and implement practices to achieve goals.
4. Characterize, conserve, and monitor genetic diversity and gene flow among local populations of bull trout.
5. Conduct research and monitoring to implement and evaluate bull trout recovery activities, consistent with an adaptive management approach using feedback from implemented, site-specific recovery tasks.
6. Use all available conservation programs and regulations to protect and conserve bull trout and bull trout habitat.
7. Assess the implementation of bull trout recovery by management units and revise management unit plans based on evaluations.

There are a number of research needs that have been identified for this management unit. A high priority goal for the Olympic Peninsula Management Unit is to acquire more complete information on the current distribution and abundance of bull trout within each core area. Additional information is also needed on bull trout use of and distribution in estuarine and marine waters of the Olympic Peninsula.

Total Estimated Cost of Recovery

The total cost of bull trout recovery in the Olympic Peninsula Management Unit is estimated at \$6.7 million spread over a 25-year recovery period, or an average of approximately \$268,000 per year. The estimate includes recovery actions associated with the Skokomish, Dungeness, Elwha, Hoh, Queets, and Quinault core areas as well as core habitats (including nearshore marine areas) and identified research needs (*e.g.*, Satsop River, Hoquiam River).

The total cost of bull trout recovery in the Puget Sound Management Unit is estimated at a minimum of \$68 million spread over a 25-year recovery timeframe, or an average of approximately \$2.7 million per year. The estimate includes recovery actions associated with the Chilliwack, Nooksack, Lower Skagit, Upper Skagit, Stillaguamish, Snohomish-Skykomish, Chester Morse, and

Puyallup core areas as well as core habitats[†] (including nearshore marine areas) and identified research needs (*e.g.*, upper Green River, upper Nisqually River).

The total cost of bull trout recovery in the Coastal-Puget Sound Distinct Population Segment is therefore estimated to be approximately \$74.7 million over 25 years. If the timeframe for recovery can be reduced, lower estimated costs would occur. Total costs include all funds expended, both public and private, and incorporate estimates of expenditures by local and State governments as well as Federal and private funds. These costs are attributed to bull trout conservation, but other aquatic species will also benefit.

Estimated Date of Recovery

Time required to achieve recovery depends on bull trout status, factors affecting bull trout, implementation and effectiveness of recovery actions, and responses to recovery actions. A tremendous amount of work will be required to restore impaired habitat, reconnect habitat, and eliminate threats from nonnative species. Three to 5 bull trout generations (15 to 25 years), or possibly longer, may be necessary before recovery is achieved.

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PART I. COASTAL-PUGET SOUND DISTINCT POPULATION SEGMENT OF BULL TROUT

INTRODUCTION AND OVERVIEW

Bull trout (*Salvelinus confluentus*), members of the family Salmonidae, are fish native to the Pacific Northwest and western Canada. Trout and salmon relatives in the genus *Salvelinus*, such as bull trout, are often generally referred to as “char[†].” Bull trout occur in five identified distinct population segments[†] within the lower 48 states. In June 1998, we, the U.S. Fish and Wildlife Service, determined threatened status under the Endangered Species Act (16 United States Code [USC] 1531 *et seq.*) for bull trout in two distinct population segments in the Klamath River (Oregon) and Columbia River (Idaho, Montana, Oregon, and Washington) (63 FR 31647). In April 1999, the Jarbidge River Distinct Population Segment of bull trout (Idaho and Nevada) was also determined to be threatened (64 FR 17110). Two more distinct population segments of bull trout, the Coastal-Puget Sound (Washington) and St. Mary-Belly River (Montana), were also found to be threatened in November, 1999 (64 FR 58910). This final listing resulted in all bull trout in the coterminous United States being listed as threatened. However, as provided in the final listing rule, we are continuing to refer to the original distinct population segments for the purposes of recovery planning and consultation (64 FR 58910). This recovery plan addresses the conservation actions deemed necessary for the recovery of the Coastal-Puget Sound Distinct Population Segment of bull trout in the Olympic Peninsula Management Unit[†] (Figure 1; also see “Recovery Plan Terminology and Structure” below).

The recovery priority number for bull trout in the coterminous United States is 9C, on a scale of 1C (highest) to 18 (lowest), indicating: 1) taxonomically, we are treating these populations as distinct population segments of the species; 2) the bull trout is subject to a moderate degree of threat; and 3) the potential for recovery is considered high. The “C” indicates the potential for conflict with human activities during recovery (USFWS 1983a,b).

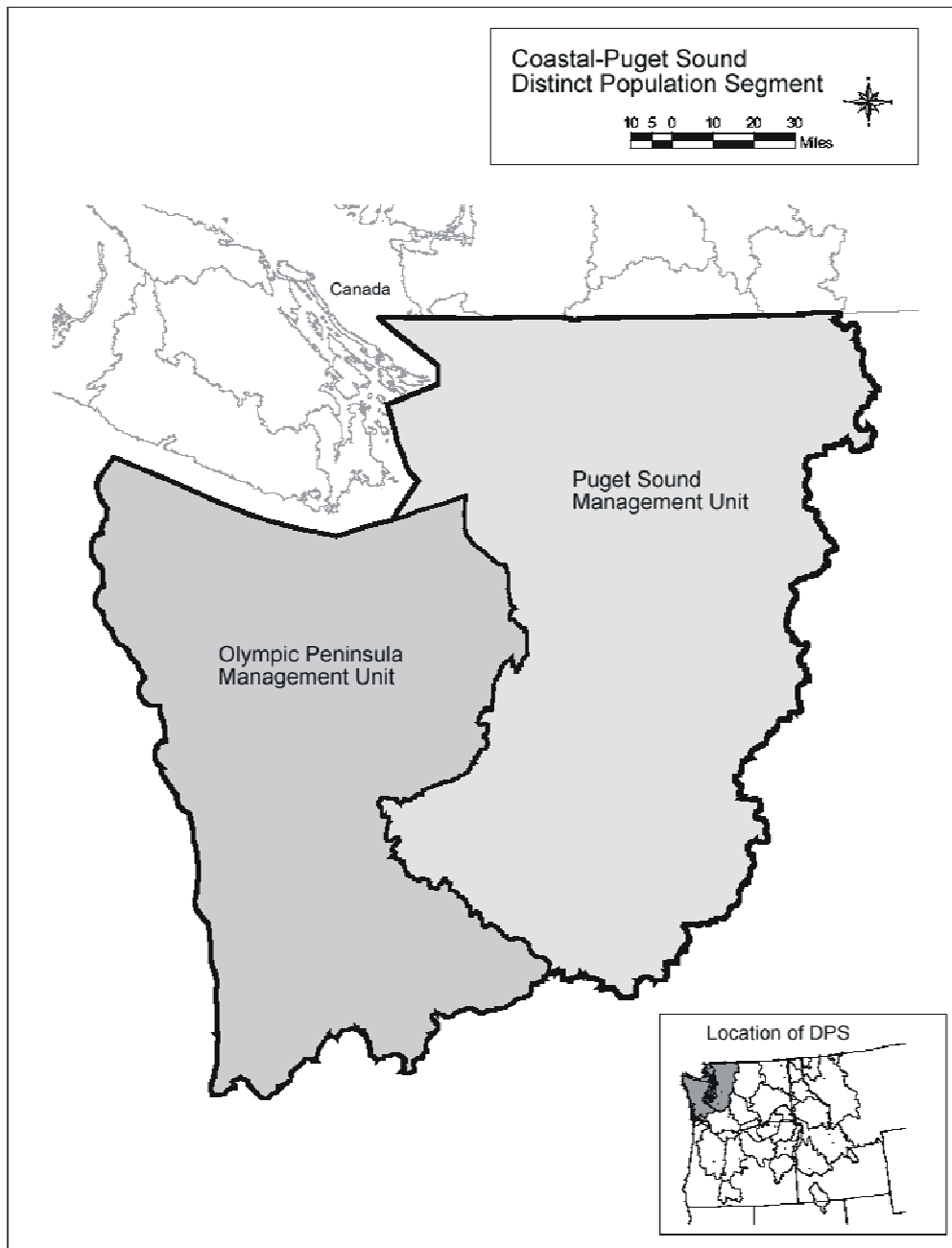


Figure 1. The Coastal-Puget Sound Distinct Population Segment (DPS) of bull trout, showing the division of the population segment into two management units. The inset map shows the location of the DPS within the state of Washington.

In the interest of streamlining, details regarding the ecology of bull trout in the Coastal-Puget Sound and the threats faced by the bull trout populations there are provided in the listing document for this distinct population segment and are not repeated here (64 FR 58910). However, a brief overview of bull trout life history, habitat needs, and reasons for decline is provided below.

General Description and Life History

Bull trout have been defined as a distinct species (Cavender 1978), however, the genetic relationship among various groups of bull trout within the species can be complex (Rieman and Allendorf 2001). Biologists had previously identified bull trout as Dolly Varden (*Salvelinus malma*), largely because of the external similarity of appearance and the previous unavailability of adequate specimens of both species to any one taxonomist. Morphological (form and structure) analyses have confirmed the distinctiveness of the two species in their different, but overlapping, geographic distributions (Haas and McPhail 1991). Several genetic studies have subsequently confirmed the species distinction of bull trout and Dolly Varden (Phillips *et al.* 1989; Crane *et al.* 1994). Both species occur together in western Washington, for example, with little or no interbreeding (Leary and Allendorf 1997). Lastly, bull trout and Dolly Varden each appear to be more closely related genetically to other species of *Salvelinus* than they are to each other (Phillips *et al.* 1989; Greene *et al.* 1990; Pleyte *et al.* 1992). For example, bull trout are most closely related to Japanese char (*S. leucomaenis*) whereas Dolly Varden are most closely related to Arctic char (*S. alpinus*).

Bull trout exhibit both resident[†] and migratory[†] life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989; Goetz 1989). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial[†] form), river (fluvial[†] form) (Fraley and Shepard 1989; Goetz 1989), or saltwater (anadromous[†]) to rear as subadults or to live as adults (Cavender 1978; McPhail and Baxter 1996; WDFW *et al.* 1997). Bull trout

normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime), and both repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Leathe and Graham 1982; Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1996).

The iteroparous reproductive system of bull trout has important repercussions for the management of this species. Bull trout require two-way passage up and downstream, not only for repeat spawning but also for foraging. Most fish ladders[†], however, were designed specifically for anadromous semelparous (fishes that spawn once and then die, and therefore require only one-way passage upstream) salmonids[†]. Therefore even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route.

Growth varies depending upon life-history strategy. Resident adults range from 150 to 300 millimeters (6 to 12 inches) total length, and migratory adults commonly reach 600 millimeters (24 inches) or more (Pratt 1985; Goetz 1989). The largest verified bull trout is a 14.6-kilogram (32-pound) specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing[†] substrate, and migratory corridors[†] (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Howell and Buchanan 1992; Pratt 1992; Rieman and McIntyre 1993, 1995; Rich 1996; Watson and Hillman 1997). Watson and Hillman (1997) concluded that watersheds[†] must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993), fish

should not be expected to simultaneously occupy all available habitats (Rieman *et al.* 1997).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Rieman and McIntyre 1993; Gilpin, *in litt.* 1997; Rieman *et al.* 1997). Migrations facilitate gene flow among local populations[†] when individuals from different local populations interbreed, or stray, to nonnatal streams. Local populations that are extirpated[†] by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates that there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a very long time (Spruell *et al.* 1999; Rieman and McIntyre 1993).

Cold water temperatures play an important role in determining bull trout habitat, as these fish are primarily found in colder streams (below 15 degrees Celsius; 59 degrees Fahrenheit), and spawning habitats are generally characterized by temperatures that drop below 9 degrees Celsius (48 degrees Fahrenheit) in the fall (Fraley and Shepard 1989; Pratt 1992; Rieman and McIntyre 1993).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed[†] (Pratt 1992; Rieman and McIntyre 1993; Rieman *et al.* 1997; Baxter *et al.* 1997). Optimum incubation temperatures for bull trout eggs range from 2 to 4 degrees Celsius (35 to 39 degrees Fahrenheit) whereas optimum water temperatures for rearing range from about 8 to 10 degrees Celsius (46 to 50 degrees Fahrenheit) (McPhail and Murray 1979; Goetz 1989; Buchanan and Gregory 1997). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8 to 9 degrees Celsius (46 to 48 degrees Fahrenheit), within a temperature gradient of 8 to 15 degrees Celsius (46 to 60 degrees Fahrenheit). In a landscape study relating bull trout distribution to maximum water temperatures, Dunham *et al.* (2003) found that the probability of juvenile bull trout occurrence does not become high (*i.e.*, greater than 0.75) until

maximum temperatures decline to 11 to 12 degrees Celsius (52 to 54 degrees Fahrenheit).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Fraley and Shepard 1989; Rieman and McIntyre 1993, 1995; Buchanan and Gregory 1997; Rieman *et al.* 1997). Factors that can influence bull trout ability to survive in warmer rivers include availability and proximity of cold water patches and food productivity (Myrick *et al.* 2002). In Nevada, adult bull trout have been collected at 17.2 degrees Celsius (63 degrees Fahrenheit) in the West Fork of the Jarbidge River (S. Werdon, U.S. Fish and Wildlife Service, pers. comm. 1998) and have been observed in Dave Creek where maximum daily water temperatures were 17.1 to 17.5 degrees Celsius (62.8 to 63.6 degrees Fahrenheit) (Werdon 2000). In the Little Lost River, Idaho, bull trout have been collected in water having temperatures up to 20 degrees Celsius (68 degrees Fahrenheit); however, bull trout made up less than 50 percent of all salmonids when maximum summer water temperature exceeded 15 degrees Celsius (59 degrees Fahrenheit) and less than 10 percent of all salmonids when temperature exceeded 17 degrees Celsius (63 degrees Fahrenheit) (Gamett 1999). In the Little Lost River study most sites that had high densities of bull trout were in an area where primary productivity increased in the streams following a fire (B. Gamett, U. S. Forest Service, pers. comm. 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris[†], undercut banks, boulders, and pools (Fraley and Shepard 1989; Goetz 1989; Hoelscher and Bjornn 1989; Sedell and Everest 1991; Pratt 1992; Thomas 1992; Rich 1996; Sexauer and James 1997; Watson and Hillman 1997). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997). These areas are sensitive to activities that directly or indirectly affect stream channel stability[†] and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring

(Fraley and Shepard 1989; Pratt 1992; Pratt and Huston 1993). Pratt (1992) indicated that increases in fine sediment[†] reduce egg survival and emergence.

Bull trout typically spawn from August to November during periods of decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989). Redds[†] are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989; Pratt 1992; Rieman and McIntyre 1996). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992), and after hatching, juveniles remain in the substrate. Time from egg deposition to emergence of fry[†] may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Pratt 1992; Ratliff and Howell 1992).

Migratory forms of bull trout appear to develop when habitat conditions allow movement between spawning and rearing streams[†] and larger rivers or lakes where foraging opportunities may be enhanced (Frissell 1993). For example, multiple life history forms (*e.g.*, resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams and lakes, greater fecundity resulting in increased reproductive potential, and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Rieman and McIntyre 1993; MBTSG 1998; Frissell 1999). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbance makes local habitats temporarily unsuitable, the range of the species is diminished, and the potential for enhanced reproductive capabilities are lost (Rieman and McIntyre 1993).

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. Resident and juvenile migratory bull trout prey

on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987; Goetz 1989; Donald and Alger 1993). Adult migratory bull trout feed on various fish species (Leathe and Graham 1982; Fraley and Shepard 1989; Brown 1994; Donald and Alger 1993). In coastal areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasii*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) in the ocean (WDFW *et al.* 1997).

Bull trout migrations and life history strategies are closely related to their feeding and foraging strategies. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one choice of food over another. For example, prey often occur in concentrated patches of abundance (“patch model”; Gerking 1998). As the predator feeds the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. In the Skagit River system, anadromous bull trout make migrations as long as 195 kilometers (121 miles) between marine foraging areas in Puget Sound and headwater[†] spawning grounds, foraging on salmon eggs and juvenile salmon along their migratory route (WDFW *et al.* 1997). Anadromous bull trout also use marine waters as migratory corridors to reach seasonal habitats in non-natal watersheds to forage and overwinter (Brenkman, *in litt.*, 2003; Brenkman and Corbett, *in litt.*, 2003; Goetz, *in litt.*, 2003a,b).

A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, but this foraging strategy can change from one life stage to another. Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994) and as fish grow their foraging strategy changes as their food changes in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, mysids[†] and small fish (Shepard *et al.* 1984; Boag 1987; Goetz 1989; Donald and Alger 1993). Bull trout 110 millimeters (4.3 inches) long or longer commonly have fish in their diet (Shepard *et al.* 1984), and bull trout of all sizes have been found to eat fish half their length (Beauchamp and Van Tassell 2001). Migratory bull trout begin growing rapidly once they move to waters with abundant forage that includes fish (Shepard *et al.* 1984; Carl 1985). As these fish mature they become larger bodied predators and are able to travel greater distances (with

greater energy expended) in search of prey species of larger size and in greater abundance (with greater energy acquired). In Lake Billy Chinook as bull trout became increasingly piscivorous[†] with increasing size, the prey species changed from mainly smaller bull trout and rainbow trout for bull trout less than 450 millimeters (17.7 inches) in length to mainly kokanee for bull trout greater in size (Beauchamp and Van Tassell 2001).

Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Bull trout likely move to or with a food source. For example, some bull trout in the Wenatchee basin were found to consume large numbers of earthworms during spring runoff in May at the mouth of the Little Wenatchee River where it enters Lake Wenatchee (USFWS, in prep.). In the Wenatchee River radio-tagged bull trout moved downstream after spawning to the locations of spawning Chinook (*Oncorhynchus tshawytscha*) and sockeye (*O. nerka*) salmon and held for a few days to a few weeks, possibly to prey on dislodged eggs, before establishing an overwintering area downstream or in Lake Wenatchee (USFWS, in prep.).

Reasons for Decline

Throughout their range in the lower 48 states bull trout have been negatively impacted by the combined effects of a variety of factors, including habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, fisheries management practices, entrainment[†], and the introduction of nonnative species[†]. Habitat alteration, primarily through the construction of impoundments, dams, and water diversions, has fragmented habitats, eliminated migratory corridors, and isolated bull trout in the headwaters of tributaries (Rieman et al. 1997; Dunham and Rieman 1999; Spruell *et al.* 1999; Rieman and Dunham 2000). The combination of such factors has resulted in rangewide declines in bull trout distribution, abundance, and habitat quality, as well as the reduction or elimination of migratory bull trout. Threats specific to bull trout within the Coastal-Puget Sound Distinct Population Segment are identified in the listing rule (64 FR 58910).

Populations of migratory bull trout require abundant fish forage and it is likely that many bull trout populations have been affected by declines in salmon

populations. Bull trout are a piscivorous fish whose existence and historical abundance throughout much of their range was historically connected with, and most likely dependent on, healthy salmon populations (Armstrong and Morrow 1980; Brown 1994; Nelson and Caverhill 1999; Baxter and Torgerson, *in litt.*, 2003). In parts of their range, especially in the Coastal-Puget Sound Distinct Population Segment, salmon continue to provide an important food source (Kraemer, *in litt.*, 2003). Food resources provided by salmon include dislodged eggs, emergent and migrating fry, and smolts[†] (juvenile fish headed to the ocean and undergoing physiological changes to adapt to saltwater). In addition, bull trout benefit from the increased productivity supplied by the decomposing carcasses of adult salmon.

Recent publications have documented the recent declines and low abundance of Pacific salmon populations throughout much of their range within the coterminous United States (WDF *et al.* 1993; NMFS 1991; NOAA, *in litt.*, 2003). In 1991, the American Fisheries Society published a status list of 214 naturally spawning stocks[†] of salmon, steelhead, and cutthroat trout from California, Oregon, Idaho and Washington. Their assessment included 101 stocks at high risk of extinction, 58 stocks at moderate risk of extinction, 54 stocks of special concern, and one classified as threatened under the Endangered Species Act (Nehlsen *et al.* 1991).

Detailed information on specific threats to bull trout in the Puget Sound Management Unit (see “Recovery Plan Terminology and Structure,” below) is provided in Part II of this plan.

SIGNIFICANCE OF THE COASTAL-PUGET SOUND DISTINCT POPULATION SEGMENT

The full array of bull trout resident and migratory life history forms[†] are found in the Coastal-Puget Sound Distinct Population Segment. Bull trout occurring here may be residents, or they may exhibit one of several migratory behaviors. Adfluvial bull trout migrate from tributary streams to a lake or reservoir to mature, and return to a tributary to spawn, and fluvial bull trout migrate from tributary streams to larger rivers to mature and then return to tributaries to spawn. Of particular significance, the Coastal-Puget Sound Distinct

Population Segment supports the only known anadromous forms of bull trout within the coterminous United States. These fish hatch in freshwater, migrate to and from the ocean to grow and live as adults, and then return to freshwater to spawn.

The restoration and preservation of the migratory life history forms of bull trout will be an important factor in providing for the recovery of the species. Migratory barriers that have resulted in the loss of the migratory forms have been shown to negatively impact bull trout by increasing the probability of losing individual local populations (Rieman and McIntyre 1993), increasing the probability of hybridization[†] with introduced brook trout (Rieman and McIntyre 1993), reducing the potential for movements in response to developmental, foraging, and seasonal habitat requirements (MBTSG 1998), reducing reproductive capability by eliminating the larger, more fecund migratory form (MBTSG 1998; Rieman and McIntyre 1993), and reducing the geographic range of the species. Restoring and maintaining migratory corridors will ensure the persistence of migratory bull trout and allow individuals access to unoccupied but suitable habitats, foraging areas, and refuges from disturbances (Saunders *et al.* 1991). Furthermore, maintenance of migratory corridors for bull trout is essential to provide connectivity[†] among local populations, and enables the reestablishment of extirpated[†] populations. Where migratory bull trout are not present, isolated populations cannot be replenished when a disturbance makes local habitats temporarily unsuitable (Rieman and McIntyre 1993; USDA and USDI 1997).

Of the five distinct population segments of bull trout, only the Coastal-Puget Sound Distinct Population Segment provides the opportunity to conserve all known life history forms of the species. In the final listing rule, we determined that the Coastal-Puget Sound Distinct Population Segment of bull trout occurs in a unique ecological setting because it supports the only known anadromous forms of bull trout in the coterminous United States. In addition, it was determined that the loss of this population segment would significantly reduce the overall range of the taxon (64 FR 58910). Since the original listing, mitochondrial DNA data has revealed genetic differences between coastal populations of bull trout, including the lower Columbia and Fraser rivers, and inland populations in the upper Columbia and Fraser river drainages east of the Cascade and Coast Mountains (Williams *et al.* 1997; Taylor *et al.* 1999). This

divergence is likely based on recolonization patterns associated with glacial refugia 10,000 to 15,000 years ago (Haas and McPhail 2001; Costello *et al.* 2003; Spruell *et al.* 2003), and suggests the existence of two or more genetically differentiated lineages of bull trout, each with a unique evolutionary legacy. Although this recent genetic evidence suggests some degree of shared evolutionary potential between all coastal populations of bull trout, these major assemblages are further subdivided at the level of major river basins (Spruell *et al.* 2003) and this, in conjunction with the unique occurrence of anadromy within the Coastal-Puget Sound Distinct Population Segment, suggests that it is appropriate to continue to focus our recovery efforts on this distinct population segment as we evaluate the potential implications of recent genetic analyses on the organization of bull trout recovery efforts.

RECOVERY PLAN TERMINOLOGY AND STRUCTURE

The bull trout is a wide-ranging species with multiple life history forms and a complex population structure reflecting a high degree of local site fidelity (Kanda and Allendorf 2001) and substantial genetic divergence between breeding populations (Dunham and Rieman 1999; Spruell *et al.* 2003). Furthermore, it has been suggested that maintaining variability in life history strategies and dispersal over many habitats may be as important to bull trout conservation as maintaining genetic variability (Rieman and Allendorf 2001). In order to preserve the diverse array of life histories and genetic variability exhibited by bull trout across their range, this recovery plan utilizes the concept of “core areas[†].” A **core area** represents a combination of suitable habitat and one or more **local populations** (the smallest group of fish that are known to represent an interacting reproductive unit) that function as one demographic unit due to occasional gene flow between them; essentially, most core areas function as metapopulations[†] (Meffe and Carroll 1994; Hanski and Gilpin 1997; Dunham and Rieman 1999). A **metapopulation** can be defined as a collection of relatively isolated, spatially distributed local populations bound together by occasional dispersal between them. Local populations may be extirpated, but can be reestablished by individuals from other local populations, although, as stated earlier, genetic analysis indicates this will likely take a very long time. In general, the characteristics of most bull trout populations appear to be consistent with the

metapopulation concept, although the exact structure of bull trout metapopulations is not well understood (Rieman and McIntyre 1993).

For the purposes of recovery, we defined core areas – which represent both suitable habitat as well as a demographically dependent grouping of local populations – as the most biologically meaningful population units to work with to ensure the long-term viability of bull trout. The key to bull trout recovery lies in providing an interconnected continuum of complex habitats which support diverse life histories and life cycles to maintain gene flow and genetic variation and facilitate metapopulation dynamics within core areas. To achieve this goal, we developed a hierarchical approach to bull trout recovery, and further subdivided the Coastal-Puget Sound Distinct Population Segment into two individual **management units**, the Puget Sound Management Unit and the Olympic Peninsula Management Unit. Focusing recovery on these smaller areas is advantageous because bull trout are broadly distributed, use a variety of habitats, and the factors affecting them vary widely at the scale of the distinct population segment. A narrower scope allows recovery actions to be tailored to specific areas and encourages the implementation of actions by local interests. The delineation of these management units was based on presumed shared genetic characteristics (*i.e.*, groupings of bull trout within isolated basins, major river basins, or collections of basins with potential for current or historical gene flow) as well as jurisdictional and logistical concerns (*e.g.*, the international boundary with Canada represents the northern boundary of the management units). The intent of the management units is to foster effective management and promote local management decisions regarding bull trout as well as to preserve the evolutionary legacy shared between the multiple bull trout core areas that comprise each of the units.

The recovery of the Coastal-Puget Sound Distinct Population Segment of bull trout will depend upon the achievement of recovery goals and criteria for the entire distinct population segment. Maintenance of fully functioning core areas across the range of bull trout within the population segment will require that each of the two management units that comprise this distinct population segment contribute to the success of this effort. In keeping with the goal of fostering effective management and recovery of bull trout at the local level, we have developed separate recovery plans for each of these management units, and

established specific “**recovery targets**” for each management unit that will be used to guide bull trout recovery within the distinct population segment as a whole.

Presently bull trout are listed across their range within the coterminous United States (64 FR 58910). Prior to the coterminous listing in 1999, five distinct population segments of bull trout were identified. Although the bull trout distinct population segments are disjunct and geographically isolated from one another, they include the entire distribution of bull trout in the coterminous United States. In accordance with our Distinct Population Segment policy (61 FR 4722), a coterminous listing was found to be appropriate when all five distinct population segments were determined to warrant listing. As provided in the final listing rule, however, we continue to refer to these populations as distinct population segments for recovery planning purposes (64 FR 58910).

A delisting determination can only be made on a “listable entity” under the Endangered Species Act; listable entities include species, subspecies, or distinct population segments of vertebrate animals, as defined by the Endangered Species Act and U.S. Fish and Wildlife Service policy (61 FR 4722). Because bull trout were listed at the coterminous level in 1999, currently delisting can only occur at the coterminous level (64 FR 58910). In the future, if warranted by additional information, and if the Coastal-Puget Sound population segment is reconfirmed as meeting the definition of a distinct population segment under a regulatory rulemaking process, delisting may be considered separately for the Coastal-Puget Sound Distinct Population Segment of bull trout once it has achieved a recovered state.

In this Strategy for Recovery section, we define the recovery criteria for the Coastal-Puget Sound Distinct Population Segment of bull trout as currently delineated. The site-specific strategies, recovery actions, and recovery targets for the Olympic Peninsula Management Unit are presented in Part II of this plan. The Puget Sound Management Unit is addressed in Volume I of the Draft Recovery Plan for the Coastal-Puget Sound Distinct Population Segment of Bull Trout.

RECOVERY GOALS AND OBJECTIVES

Recovery Goal

The goal of this recovery plan is to **ensure the long-term persistence of self-sustaining, complex, interacting groups[†] of bull trout distributed across the Coastal-Puget Sound Distinct Population Segment so that the species can be delisted.** To accomplish this goal, recovery objectives addressing distribution, abundance, habitat and genetics were identified.

Recovery Objectives

The recovery objectives for the Coastal-Puget Sound Distinct Population Segment are as follows:

- Maintain the current distribution of bull trout anadromy and restore migratory life history forms in some of the previously occupied areas.
- Maintain stable or increasing trends in abundance of bull trout.
- Restore and maintain suitable habitat conditions for all bull trout life history stages and strategies with an emphasis on anadromy.
- Conserve genetic diversity and provide opportunity for genetic exchange to conserve migratory life history forms.

Recovery Criteria

Achieving recovery criteria and making formal delisting decisions are two separate processes. Delisting requires that a five factor analysis¹ in a regulatory

¹The five factors considered in delisting decisions are the same as those considered in the initial listing process for a species: a) the present or threatened destruction, modification, or curtailments of its habitat or range; b) overutilization for commercial, recreational, scientific, or educational purposes; c) disease or predation; d) the inadequacy of existing regulatory mechanisms; and e) other natural or manmade factors affecting its continued existence.

rulemaking process demonstrates that the threats to the species have been reduced or eliminated to the point that the species no longer requires the protections of the Endangered Species Act. The recovery criteria established in a recovery plan for a threatened species, such as the bull trout, are intended to serve as clear, measurable guidelines for assessing the conditions under which such a five factor analysis would likely result in a determination that the species warrants delisting (*i.e.*, that it no longer meets the definition of “threatened,” which is “any species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range”). A delisting decision therefore considers both the attainment of the recovery criteria as defined in a recovery plan and the outcome of a formal five factor analysis in a regulatory rulemaking.

The Coastal-Puget Sound Distinct Population Segment will be considered recovered when all core areas are fully functional, as measured by parameters addressing the distribution, abundance, productivity (stable or increasing adult population trend), and connectivity (including the potential for expression of all life history traits) of bull trout. The conditions for recovery are identified in the criteria below. The recovery actions identified in this plan are designed to sufficiently control or eliminate the threats to bull trout such that the recovery criteria may be attained for the Coastal Puget Distinct Population Segment of bull trout.

Recovery criteria for the Coastal-Puget Sound Distinct Population Segment:

- 1. The biological and ecological function of the 14 identified core areas (8 in the Puget Sound Management Unit and 6 in the Olympic Peninsula Management Unit) for bull trout within the distinct population segment has been restored. The components of fully functioning core areas include:**
 - a) Habitat sufficiently maintained or restored to provide for the persistence of broadly distributed local populations supporting the migratory life form within each core area.** The term “broadly distributed” implies that local populations are able to access and are actively using habitat that fully provides for spawning, rearing,

foraging, migrating, and overwintering needs at recovered abundance levels. An actual quantitative estimate of the amount of habitat that will be required to meet this criterion is unknown at this time; the adequacy of habitat restoration and management efforts must be measured indirectly by criteria 1b through 1d. The currently identified local populations that will be used as a measure of broad distribution across the distinct population segment are detailed in the recovery targets set for each of the two management units.

b) Adult bull trout are sufficiently abundant to provide for the persistence and viability of core areas; this level of abundance is estimated to be 16,500 adult bull trout across all core areas.

Resident life history forms are not included in this estimate, but are considered a research need. As more data is collected, recovered population estimates will be revised to more accurately reflect both the migratory and resident life history components. The recovery team[†] has initially set abundance targets conservatively if there was limited available information for constituent core areas; these will likely be revised as new information becomes available. The recovered abundance levels for the currently identified core areas in the distinct population segment are detailed in the recovery targets set for each of the two management units.

c) Measures of bull trout abundance within all core areas show stable or increasing trends based on 10 to 15 years (representing at least 2 bull trout generations) of monitoring data. Details are provided in the recovery targets for each of the two management units.

d) Habitat within, and where appropriate, between core areas, is connected so as to provide for the potential of the full expression of migratory behavior (particularly anadromy), allow for the refounding[†] of extirpated populations, and provide for the potential of genetic exchange between populations. Meeting this criterion requires that passage has been restored or improved, and in some cases further evaluated, at specific barriers identified as inhibiting recovery (including barriers due to physical obstructions,

unsuitable habitat, and poor water quality). Known barriers to passage within the Olympic Peninsula Management Unit include Cushman Dams 1 and 2, Elwha Dam and Glines Canyon Dam, the Washington Department of Fish and Wildlife Dungeness Fish Hatchery, and U.S. Fish and Wildlife Service Quinalt National Fish Hatchery. Known barriers to passage within the Puget Sound Management Unit include the Bellingham Diversion, Gorge Dam, Ross Dam, Tacoma Headworks diversion dam, and Howard Hansen Dam; the Baker River Dams and Electron and Buckley diversions are also in need of passage improvement. Details regarding these specific barriers are provided in the recovery targets set for each of the two management units.

Meeting this criterion also requires that conditions in both freshwater and nearshore marine foraging, migration, and overwintering habitats[†] are maintained and/or restored to the level that fully support an adequate prey base, especially for the anadromous forms, as well as the other identified components (distribution, abundance, and trend) for fully functional core areas within the Coastal-Puget Sound population segment.

- 2. A monitoring plan has been developed and is ready for implementation, to cover a minimum of 5 years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.**

PART II. OLYMPIC PENINSULA MANAGEMENT UNIT

INTRODUCTION

Management Unit Designation

As described in Part I of this plan, two management units, the Olympic Peninsula and the Puget Sound, have been designated in the Coastal-Puget Sound Distinct Population Segment of bull trout based on presumed biological and genetic factors common to bull trout within specific geographic areas (Figure 1).

Although genetic data informing population structure in this area is incomplete, we believe that Olympic Peninsula bull trout populations differ from populations in watersheds that originate on the western slopes of the Cascade Mountains and flow into Puget Sound. Although these two management units are connected by marine waters, there is currently no evidence indicating that bull trout migrate from Puget Sound to the Strait of Juan de Fuca or Hood Canal in the Olympic Peninsula Management Unit. Recent studies suggest that migrations through marine waters are more localized in nature (Kraemer 1994; F. Goetz, U.S. Army Corps of Engineers, pers. comm. 2002a).

The Olympic Peninsula and Puget Sound Management Units for bull trout differ slightly from Washington State's salmon recovery regions described in the 1999 draft statewide strategy to recover salmon, "Extinction Is Not An Option" (WGSRO 1999). The salmon recovery strategy includes Hood Canal watersheds and some Strait of Juan de Fuca watersheds in the Puget Sound Region.

The Olympic Peninsula Management Unit includes selected rivers and tributaries to Hood Canal, Strait of Juan de Fuca, Pacific Ocean coastal area north of Willapa Bay, Grays Harbor, and Chehalis River. Although data and records regarding the historical distribution of bull trout in the Olympic Peninsula Management Unit are limited, observations indicate that mainstem reaches and many tributaries within the Quinault, Queets, Hoh, Elwha, Dungeness, and Skokomish Rivers are occupied or used by bull trout at various life stages (see "Distribution and Abundance"). Other information indicates that bull trout from several of these rivers migrate into saltwater to forage and travel along the coast and into coastal tributaries, bays, or estuaries to reach additional foraging and overwintering sites.

The Olympic Peninsula Recovery Team[†] has identified the Quinault, Queets, Hoh, Elwha, Dungeness, and Skokomish River basins, which contain the only known bull trout core populations[†] in the management unit, as six separate core areas (Figure 2). The combination of core habitat[†] (*i.e.*, habitat that could supply all the necessary elements for the long-term security of bull trout including both spawning and rearing, foraging, migrating, and overwintering habitat) and a core population comprises a core area. A core area is the basis for measuring recovery in a management unit. A local population is defined as a group of bull

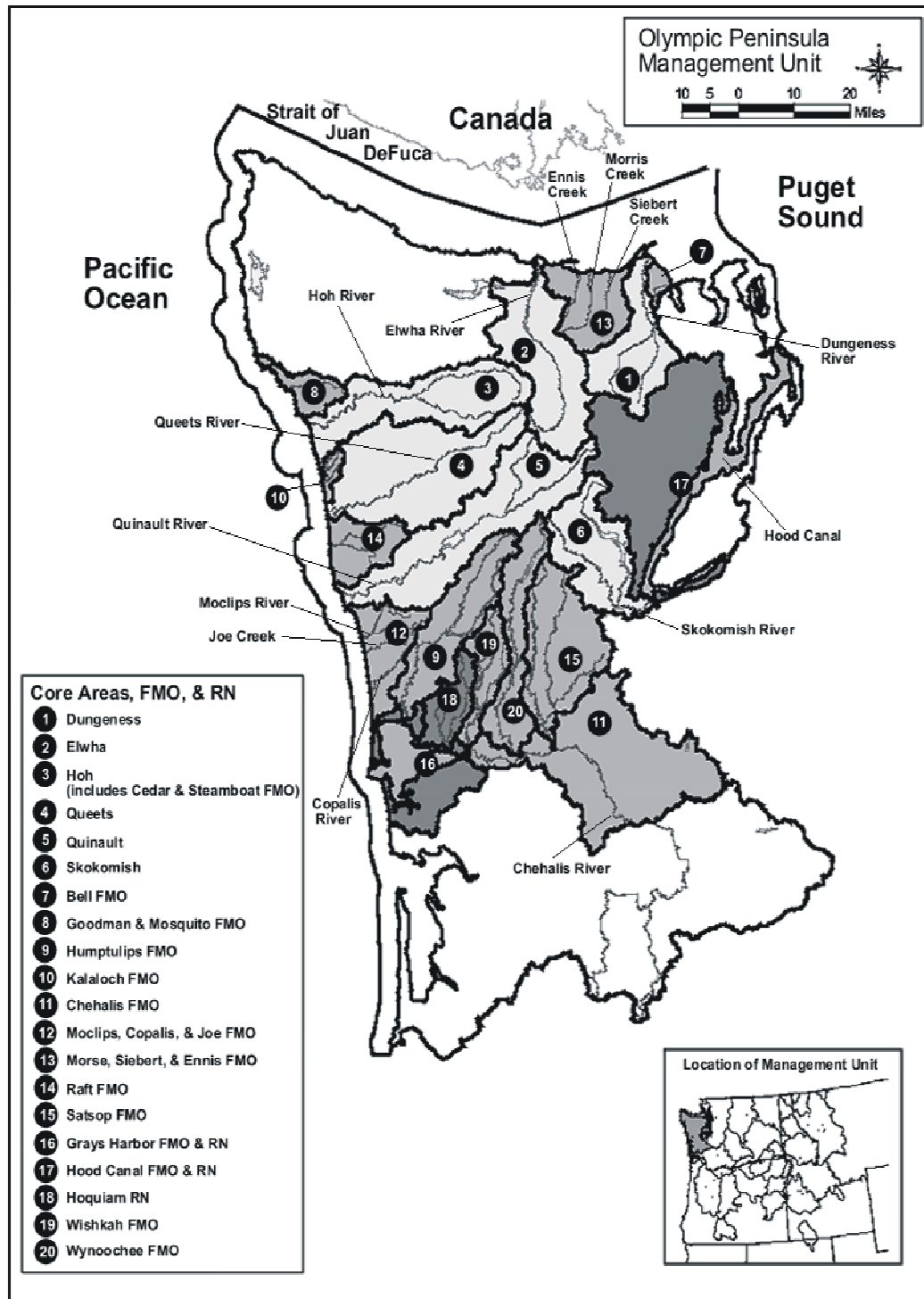


Figure 2. Olympic Peninsula Management Unit showing the six identified core areas; important foraging, migration, and overwintering habitats (FMO); and research needs areas (RN) for bull trout.

trout that spawn within a particular stream or portion of a stream system. A local population is considered to be the smallest group of bull trout that is known to represent an interacting reproductive unit, and may include more than one stream if the recovery team determines that this grouping constitutes an interacting reproductive unit. A core area may include many local populations.

Bull trout populations within the Olympic Peninsula Management Unit exhibit all known migratory life history forms of this species, including fluvial (fish that migrate from tributaries to larger rivers to mature), adfluvial (fish that migrate from tributaries to lakes or reservoirs to mature), and anadromous (fish born in fresh water that migrate to the ocean to grow and live as an adult, returning to fresh water to spawn) populations. Additional bull trout surveys may document resident life forms (nonmigratory fish, living in tributaries for their entire lives) as well, which are not yet documented on the Olympic Peninsula.

Ten local populations have been identified in the six core areas in the Olympic Peninsula Management Unit (Table 1). Where specific spawning location information was lacking, the Olympic Peninsula Recovery Team used best professional judgement and local expertise to identify some local populations that include bull trout in a complex of tributaries, or where multiple age classes[†] have been observed, and where suitable spawning habitat occurs. Within a local population all or most of the accessible tributaries are considered occupied by bull trout. These accessible tributaries often have only short reaches of accessible habitat. Although spawning information is limited for the Olympic Peninsula, spawning has been documented in this type of short accessible reach (Brenkman and Meyer 1999; Ogg and Stutsman 2002).

Geographic Description of Management Unit

Geography and Landownership. The Olympic Peninsula is a relatively isolated province bordered on three sides by water: the Pacific Ocean (west), Strait of Juan de Fuca (north), and Hood Canal (east). The Chehalis River defines much of the southern boundary. The Olympic Mountains comprise the central portion of the Olympic Peninsula, and high elevation ridges radiate from the interior mountains to form the boundaries of the major river basins. Elevations